

Chapter 2

Groundwater Management in California

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Groundwater management, as defined in this report, is the planned and coordinated monitoring, operation, and administration of a groundwater basin or portion of a groundwater basin with the goal of long-term sustainability of the resource. Throughout the history of water management in California, local agencies have practiced an informal type of groundwater management. For example, since the early 20th century, when excess surface water was available, some agencies intentionally recharged groundwater to augment their total water supply. In 1947, the amount of groundwater used was estimated at 9 million to 10 million acre-feet. By the beginning of the 21st century, the amount of groundwater used had increased to an estimated 15 million acre-feet. Better monitoring would provide more accurate information. This increased demand on California's groundwater resources, when coupled with estimates of population growth, has resulted in a need for more intensive groundwater management.

In 1914, California created a system of appropriating surface water rights through a permitting process (Stats 1913, ch. 586), but groundwater use has never been regulated by the State. Though the regulation of groundwater has been considered on several occasions, the California Legislature has repeatedly held that groundwater management should remain a local responsibility (Sax 2002). Although they are treated differently legally, groundwater and surface water are closely interconnected in the hydrologic cycle. Use of one resource will often affect the other, so that effective groundwater management must consider surface water supplies and uses.

Figure 7 depicts the general process by which groundwater management needs are addressed under existing law. Groundwater management needs are identified at the local water agency level and may be directly resolved at the local level. If groundwater management needs cannot be directly resolved at the local agency level, additional actions such as enactment of ordinances by local governments, passage of laws by the Legislature, or decisions by the courts may be necessary to resolve the issues. Upon implementation, local agencies evaluate program success and identify additional management needs. The State's role is to provide technical and financial assistance to local agencies for their groundwater management efforts, such as through the Local Groundwater Assistance grant program (see Chapter 4, AB 303).

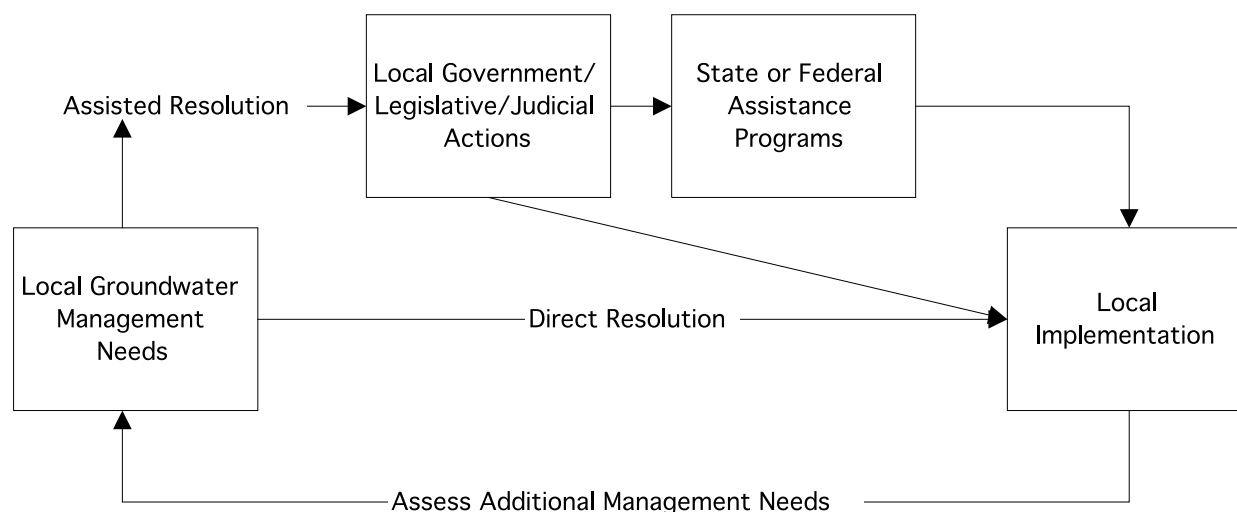


Figure 7 Process of addressing groundwater management needs in California

How Groundwater is Managed in California

There are three basic methods available for managing groundwater resources in California: (1) management by local agencies under authority granted in the California Water Code or other applicable State statutes, (2) local government groundwater ordinances or joint powers agreements, and (3) court adjudications. Table 1 shows how often each of these methods has been used, and each method is discussed briefly below. No law requires that any of these forms of management be applied in a basin. Management is often instituted after local agencies or landowners recognize a specific groundwater problem. The level of groundwater management in any basin or subbasin is often dependent on water availability and demand.

Table 1 Groundwater management methods

Method	Frequency of use ^a
Local water agencies	<p>Undetermined number of agencies with authority to manage some aspect of groundwater under general powers associated with a particular type of district.</p> <p>Thirteen agencies with specially legislated authority to limit or regulate extraction.</p> <p>Seven agencies with adopted plans under authority from Water Code Section 10750 et seq.^b (AB 255 of 1991).</p> <p>More than 200 agencies with adopted plans under authority from Water Code Section 10750 et seq. (AB 3030 of 1992).</p>
Local groundwater management ordinances	Currently adopted in 27 counties.
Court adjudication	<p>Currently decided in 19 groundwater basins, mostly in Southern California.</p> <p>Three more basins are in court.</p>

a. The numbers for some methods are unknown because reporting to the California Department of Water Resources is not required.

b. Section 10750 *et seq.* was amended in 1992.

Groundwater Management through Authority Granted to Local Water Agencies

More than 20 types of local agencies are authorized by statute to provide water for various beneficial uses. Many of these agencies also have statutory authority to institute some form of groundwater management. For example, a Water Replenishment District (Water Code, § 60000 et seq.) is authorized to establish groundwater replenishment programs and collect fees for that service. A Water Conservation District (Water Code, § 75500 et seq.) can levy groundwater extraction fees. Table 2 lists these and other types of local agencies that deliver water and may have authority to institute some form of groundwater management. Most of these agencies are identified in the Water Code, but their specific authority related to groundwater management varies. The Water Code does not require that the agencies report their activities to the California Department of Water Resources (DWR).

Table 2 Local agencies with authority to deliver water for beneficial uses, which may have authority to institute groundwater management

Local agency	Authority	Number of agencies ^a
Community Services District	Gov. Code § 61000 et seq.	313
County Sanitation District	Health and Safety Code § 4700 et seq.	91
County Service Area	Gov. Code § 25210.1 et seq.	897
County Water Authority	Water Code App. 45.	30
County Water District	Water Code § 30000 et seq.	174
County Waterworks District	Water Code § 55000 et seq.	34
Flood Control and Water Conservation District	Water Code App. 38.	39
Irrigation District	Water Code § 20500 et seq.	97
Metropolitan Water District	Water Code App 109.	1
Municipal Utility District	Pub. Util. Code § 11501 et seq.	5
Municipal Water District	Water Code § 71000 et seq.	40
Public Utility District	Pub. Util. Code § 15501 et seq.	54
Reclamation District	Water Code § 50000 et seq.	152
Recreation and Park District	Pub. Resources Code § 5780 et seq.	110
Resort Improvement District	Pub. Resources Code § 13000 et seq.	-
Resource Conservation District	Pub. Resources Code § 9001 et seq.	99
Water Conservation District	Water Code App. 34; Wat. Code § 74000 et seq.	13
Water District	Water Code § 34000 et seq.	141
Water Replenishment District	Water Code § 60000 et seq.	1
Water Storage District	Water Code § 39000 et seq.	8

a. From State Controller's Office Special Districts Annual Report, 49th Edition.

Greater authority to manage groundwater has been granted to a small number of local agencies or districts created through special acts of the Legislature. For example, the Sierra Valley Groundwater Basin Act of 1980 (Water Code, App. 119) created the first two groundwater management districts in California. Currently, 13 local agencies have specific groundwater management authority as a result of being special act districts. The specific authority of each agency varies, but they can generally be grouped into two categories. Most of the agencies formed since 1980 have the authority to limit export and even control some in-basin extraction upon evidence of overdraft or the threat of overdraft. These agencies can also generally levy fees for groundwater management activities and for water supply replenishment. Agencies formed prior to 1980 do not have authority to limit extraction from a basin. However, the groundwater users in these areas are generally required to report extractions to the agency, and the agency can levy fees for groundwater management or water supply replenishment. Some of these agencies have effectively used a tiered fee

structure to discourage excessive groundwater extraction in the basin. Table 3 lists the names of special act districts with legislative authority to manage groundwater.

Table 3 Special act districts with groundwater management authority in California

District or agency	Water Code citation ^a	Year agency established in Code ^b
Desert Water Agency	App. 100	1961
Fox Canyon Groundwater Management Agency	App. 121.	1982
Honey Lake Groundwater Management District	App. 129.	1989
Long Valley Groundwater Management District	App. 119.	1980
Mendocino City Community Services District	Section 10700 et seq.	1987
Mono County Tri-Valley Groundwater Management District	App. 128.	1989
Monterey Peninsula Water Management District	App. 118.	1977
Ojai Groundwater Management Agency	App. 131.	1991
Orange County Water District	App. 40.	1933
Pajaro Valley Water Management Agency	App. 124.	1984
Santa Clara Valley Water District	App. 60.	1951
Sierra Valley Groundwater Management District	App. 119.	1980
Willow Creek Groundwater Management Agency	App. 135.	1993

a. From West's Annotated California Codes (1999 update)

b. This represents the year the agency was established in the Water Code. Specific authorities, such as those for groundwater management activities, may have been granted through later amendments.

In 1991, AB 255 (Stats. 1991, Ch. 903) was enacted authorizing local agencies overlying basins subject to critical conditions of overdraft, as defined in DWR's Bulletin 118-80, to establish programs for groundwater management within their service areas. Water Code section 10750 et seq. provided these agencies with the powers of a water replenishment district to raise revenue for facilities to manage the basin for the purposes of extraction, recharge, conveyance, and water quality. Seven local agencies adopted plans under this authority.

The provisions of AB 255 were repealed in 1992 with the passage of AB 3030 (Stats. 1992, Ch. 947). This legislation was significant in that it greatly increased the number of local agencies authorized to develop a groundwater management plan and set forth a common framework for management by local agencies throughout California. AB 3030, which is codified in Water Code section 10750 et seq., provides a systematic procedure to develop a groundwater management plan by local agencies overlying the groundwater basins defined by Bulletin 118-75 (DWR 1975) and updates. Upon adoption of a plan, these agencies could possess the same authority as a water replenishment district to "fix and collect fees and assessments for groundwater management" (Water Code, § 10754). However, the authority to fix and collect these fees and assessments is contingent on receiving a majority of votes in favor of the proposal in a local election (Water Code, § 10754.3). More than 200 agencies have adopted an AB 3030 groundwater management plan. None of these agencies is known to have exercised the authority of a Water Replenishment District.

Water Code section 10755.2 expands groundwater management opportunities by encouraging coordinated plans and by authorizing public agencies to enter into a joint powers agreement or memorandum of understanding with public or private entities that provide water service. At least 20 coordinated plans have been prepared to date involving nearly 120 agencies, including cities and private water companies.

Local Groundwater Ordinances

A second general method of managing groundwater in California is through ordinances adopted by local governments such as cities or counties. Twenty-seven counties have adopted groundwater ordinances, and others are being considered (Figure 8). The authority of counties to regulate groundwater has been challenged, but in 1995 the California Supreme Court declined to review an appeal of a lower court decision *Baldwin v. County of Tehama* (1994) that holds that State law does not occupy the field of groundwater management and does not prevent cities and counties from adopting ordinances to manage groundwater under their police powers. However, the precise nature and extent of the police power of cities and counties to regulate groundwater is uncertain.

The Public Policy Institute of California recently performed a study of California's water transfer market, which included a detailed investigation of the nature of groundwater ordinances by counties in California. The report found that 22 counties had adopted ordinances requiring a permit to export groundwater. In all but three cases, restricting out-of-county uses appears to be the only purpose (Hanak 2003). One ordinance, adopted recently in Glenn County (Box D, "Basin Management Objectives for Groundwater Management"), takes a comprehensive approach by establishing management objectives for the county's groundwater basins. Several other counties in Northern California are considering adopting similar management objective based ordinances.

Ordinances are mostly a recent trend in groundwater management, with 24 of the 27 ordinances enacted since 1990. Local ordinances passed during the 1990s have significantly increased the potential role of local governments in groundwater management. The intent of most ordinances has been to hold project proponents accountable for impacts that may occur as a result of proposed export projects. Because adoption of most of these ordinances is recent, their effect on local and regional groundwater management planning efforts is not yet fully known. However, it is likely that future groundwater development will take place within the constraints of local groundwater management ordinances. Table 4 lists counties with groundwater management ordinances and their key elements.



Figure 8 Counties with groundwater ordinances

Box D Basin Management Objectives for Groundwater Management

Most county groundwater management ordinances require that an export proponent prove the project will not deplete groundwater, cause groundwater quality degradation, or result in land subsidence. Although these factors could be part of any groundwater management plan, these ordinances do not require that a groundwater management plan be developed and implemented.

The only ordinance requiring development and adoption of objectives to be accomplished by management of the basin was adopted by the Glenn County Board of Supervisors in 2000. The action came after a citizens committee spent five years working with stakeholders. The process of developing a groundwater management ordinance for Glenn County began in 1995 when local landowners and county residents became concerned about plans to export groundwater or substitute groundwater for exported surface water. Control of exports was the focus of early ordinance discussions.

After long discussions and technical advice from groundwater specialists, the committee realized that goals and objectives must be identified for effective management of groundwater in the county. What did the county want to accomplish by managing groundwater within the county? What did groundwater management really mean?

The concept of establishing basin management objectives emerged (BMOs). BMOs would establish threshold values for groundwater levels, groundwater quality, and land surface subsidence. When a threshold level is reached, the rules and regulations require that groundwater extraction be adjusted or stopped to prevent exceeding the threshold.

The Glenn County Board of Supervisors has adopted BMOs, which were developed by an advisory committee, for groundwater levels throughout the county. While currently there are 17 BMOs representing the 17 management areas in the county, the goal is to begin managing the entire county in a manner that benefits each of the local agencies and their landowners, as well as landowners outside of an agency boundary. The committee is now developing BMOs for groundwater quality and land surface subsidence.

There is no single set of management objectives that will be successful in all areas. Groundwater management must be adapted to an area's political, institutional, legal, and technical constraints and opportunities. Groundwater management must be tailored to each basin or subbasin's conditions and needs. Even within a single basin, the management objectives may change as more is learned about managing the resource within that basin. Flexibility is the key, but that flexibility must operate within a framework that ensures public participation, monitoring, evaluation, feedback on management alternatives, rules and regulations, and enforcement.

Table 4 Counties with ordinances addressing groundwater management

County	Year enacted	Key elements (refer to ordinances for exemptions and other details)
Butte	1996	Export permit required (extraction & substitute pumping), Water Commission and Technical Advisory Committee, groundwater planning reports (county-wide monitoring program)
Calaveras	2002	Export permit required (extraction & substitute pumping)
Colusa	1998	Export permit required (extraction & substitute pumping)
Fresno	2000	Export permit required (extraction & substitute pumping)
Glenn	1990 rev. 2000	Water Advisory Committee and Technical Advisory Committee, basin management objectives and monitoring network, export permit required (1990)
Imperial	1996	Commission established to manage groundwater, including controlling exports (permit required), overdraft, artificial recharge, and development projects
Inyo	1998	Regulates (1) water transfers pursuant to Water Code Section 1810, (2) sales of water to the City of Los Angeles from within Inyo Co., (3) transfer or transport of water from basins within Inyo County to another basin with the County, and (4) transfers of water from basins within Inyo Co. to any area outside the County.
Kern	1998	Conditional use permit for export to areas both outside county and within watershed area of underlying aquifer in county. Only applies to southeastern drainage of Sierra Nevada and Tehachapi mountains.
Lake	1999	Export permit required (extraction & substitute pumping)
Lassen	1999	Export permit required (extraction & substitute pumping)
Madera	1999	Permit required for export, groundwater banking, and import for groundwater banking purposes to areas outside local water agencies
Mendocino	1995	Mining of groundwater regulated for new developments in Town of Mendocino
Modoc	2000	Export permit required for transfers out of basin
Mono	1988	Permit required for transfers out of basin
Monterey	1993	Water Resources Agency strictly regulates extraction facilities in zones with groundwater problems
Napa	1996	Permits for local groundwater extractions; exemptions for single parcels and agricultural use
Sacramento	1952 rev. 1985	Water Agency established to manage and protect groundwater management zones; replenishment charges
San Benito	1995	Mining groundwater (overdraft) for export prohibited; permit required for off-parcel use, injecting imported water; influence of well pumping restrictions
San Bernardino	2002	Permit required for any new groundwater well within the desert region of the county
San Diego	1991	Provides for mapping of groundwater impacted basins (defined); projects within impacted basins require groundwater investigations
San Joaquin	1996	Export permit required (extraction & substitute pumping)
Shasta	1997	Export permit required (extraction & substitute pumping)
Sierra	1998	Export permit required or for off-parcel use
Siskiyou	1998	Permit required for transfers out of basin
Tehama	1992	Mining groundwater (overdraft) for export prohibited; permit required for off-parcel use; influence of well pumping restrictions
Tuolumne	2001	Export permit required (extraction & substitute pumping)
Yolo	1996	Export permit required (extraction & substitute pumping)

Adjudicated Groundwater Basins

A third general form of groundwater management in California is court adjudication. In some California groundwater basins, as the demand for groundwater exceeded supply, landowners and other parties turned to the courts to determine how much groundwater can rightfully be extracted by each user. The courts study available data to arrive at a distribution of the groundwater that is available each year, usually based on the California law of overlying use and appropriation. This court-directed process can be lengthy and costly. As noted in Table 5, the longest adjudication took 24 years. Many of these cases have been resolved with a court-approved negotiated settlement, called a stipulated judgment. Unlike overlying and non-overlying rights to groundwater, such decisions guarantee to each party a proportionate share of the groundwater that is available each year. The intense technical focus on the groundwater supply and restrictions on groundwater extraction for all parties make adjudications one of the strongest forms of groundwater management in California.

There are 19 court adjudications for groundwater basins in California, mostly in Southern California (see Table 5). Eighteen of the adjudications were undertaken in State Superior Court and one in federal court. For each adjudicated groundwater basin, the court usually appoints a watermaster to oversee the court judgment. In 15 of these adjudications, the court judgment limits the amount of groundwater that can be extracted by all parties based on a court-determined safe yield of the basin. The basin boundaries are also defined by the court. The Santa Margarita Basin was adjudicated in federal court. That decision requires water users to report the amount of surface water and groundwater they use, but groundwater extraction is not restricted.

Most basin adjudications have resulted in either a reduction or no increase in the amount of groundwater extracted. As a result, agencies often import surface water to meet increased demand. The original court decisions provided watermasters with the authority to regulate extraction of the quantity of groundwater; however, they omitted authority to regulate extraction to protect water quality or to prevent the spread of contaminants in the groundwater. Because water quantity and water quality are inseparable, watermasters are recognizing that they must also manage groundwater quality.

Box E Adjudication of Groundwater Rights in the Raymond Basin

The first basin-wide adjudication of groundwater rights in California was in the Raymond Basin in Los Angeles County in 1949 (*Pasadena v. Alhambra*). The first water well in Raymond Basin was drilled in 1881; 20 years later, the number of operating wells grew to about 140. Because of this pumping, the City of Pasadena began spreading water in 1914 to replenish the groundwater, and during the next 10 years the city spread more than 20,000 acre-feet.

Pumping during 1930 through 1937 caused water levels to fall 30 to 50 feet in wells in Pasadena. After attempting to negotiate a reduction of pumping on a cooperative basis, the City of Pasadena, on September 23, 1937, filed a complaint in Superior Court against the City of Alhambra and 29 other pumpers to quiet title to the water rights within Raymond Basin. The court ruled that the city must amend its complaint, making defendants of all entities pumping more than 100 acre-feet per year, and that it was not a simple quiet title suit but, a general adjudication of the water rights in the basin.

In February 1939, a court used the reference procedure under the State Water Code to direct the State Division of Water Resources, Department of Public Works (predecessor to the Department of Water Resources) as referee to review all physical facts pertaining to the basin, determine the safe yield, and ascertain whether there was a surplus or an overdraft. The study took 2-1/2 years to complete and cost more than \$53,000, which was paid by the parties. The resulting Report of Referee submitted to the court in July 1943 found that the annual safe yield of the basin was 21,900 acre-feet but that the actual pumping and claimed rights were 29,400 acre-feet per year.

Most parties agreed to appoint a committee of seven attorneys and engineers to work out a stipulated agreement. In 1944, the court designated the Division of Water Resources to serve as watermaster for the stipulated agreement, which all but one of the parties supported. On December 23, 1944, the judge signed the judgment that adopted the stipulation.

The stipulation provided that (1) the water was taken by each party openly, notoriously, and under a claim of right, which was asserted to be, and was adverse to each and all other parties; (2) the safe yield would be divided proportionally among the parties; and (3) each party's right to a specified proportion of the safe yield would be declared and protected. It also established an arrangement for the exchange of pumping rights among parties.

Based on the stipulation, the court adopted a program of proportionate reductions. In so doing, the court developed the doctrine of mutual prescription, whereby the rights were essentially based on the highest continual amount of pumping during the five years following the beginning of the overdraft, and under conditions of overdraft, all of the overlying and appropriative water users had acquired prescriptive rights against each other, that is, mutual prescription.*

In 1945, one party appealed the judgment, and in 1947, the District Court of Appeals reversed and remanded *Pasadena v. Alhambra*. However, on June 3, 1949, the State Supreme Court overturned the appellate court's decision and affirmed the original judgment. In 1950, the court granted a motion by the City of Pasadena that there be a review of the determination of safe yield, and in 1955, the safe yield and the total decreed rights were increased to 30,622 acre-feet per year. In 1984, watermaster responsibilities were assigned to the Raymond Basin Management Board.

*In *City of Los Angeles v. City of San Fernando* (1975) the California Supreme Court rejected the doctrine of mutual prescription and held that a groundwater basin should be adjudicated based on the correlative rights of overlying users and prior appropriation among non-overlying users. For further discussion, see Appendix B.

Table 5 List of adjudicated basins

Court name	Relationship to DWR Bulletin 118 basin name; county	Basin No.	Filed in court	Final decision	Watermaster and/or website
1—Scott River Stream System	Scott River Valley; Siskiyou	1-5	1970	1980	Two local irrigation districts
2—Santa Paula Basin	Subbasin of Santa Clara River; Ventura	4-4	1991	1996	Three-person technical advisory committee from United Water CD, City of Ventura, and Santa Paula Basin Pumps Association; www.unitedwater.org
3—Central Basin	Northeast part of Coastal Plain of Los Angeles County Basin; Los Angeles	4-11	1962	1965	DWR—Southern District; www.dpla.water.ca.gov/sd/watermaster/watermaster.html
4—West Coast Basin	Southwest part of Coastal Plain of Los Angeles County Basin; Los Angeles	4-11	1946	1961	DWR—Southern District; www.dpla.water.ca.gov/sd/watermaster/watermaster.html
5—Upper Los Angeles River Area	San Fernando Valley Basin (entire watershed); Los Angeles	4-12	1955	1979	Superior Court appointee
6—Raymond Basin	Northwest part of San Gabriel Valley Basin; Los Angeles	4-13	1937	1944	Raymond Basin Management Board
7—Main San Gabriel Basin	San Gabriel Valley Basin, excluding Raymond Basin; Los Angeles	4-13	1968	1973	Water purveyors and water districts elect a nine-member board; www.watermaster.org/
Puente Narrows, <i>Addendum to Main San Gabriel Basin decision</i>			1972	1972	Two consulting engineers
			1985	1985	Three consultants
8—Puente	San Gabriel Valley Basin, excluding Raymond Basin; Los Angeles	4-13			
9—Cummings Basin	Cummings Valley Basin; Kern	5-2	1966	1972	Tehachapi-Cummings County Water District; www.tccwd.com/gwm.htm
10—Tehachapi Basin	Tehachapi Valley West Basin and Tehachapi Valley East Basin; Kern	5-28 6-45	1966	1973	Tehachapi-Cummings County Water District; www.tccwd.com/gwm.htm
11—Brite Basin	Brite Valley; Kern	5-80	1966	1970	Tehachapi-Cummings County Water District; www.tccwd.com/gwm.htm

Table 5 List of adjudicated basins (continued)

Court name	Relationship to DWR Bulletin 118 basin name; county	Basin No.	Filed in court	Final decision	Watermaster and/or website
12—Mojave Basin Area Adjudication	Lower, Middle & Upper Mojave River Valley Basins; El Mirage & Lucerne valleys; San Bernardino	6-40, 6-41, 6-42	1990	1996	Mojave Water Agency; www.mojavewater.org/mwa700.htm
13—Warren Valley Basin	Part of Warren Valley Basin; San Bernardino	7-12	1976	1977	Hi-Desert Water District; www.mojavewater.org
14—Chino Basin	Northwest part of Upper Santa Ana Valley Basin; San Bernardino and Riverside	8-2	1978	1978	Nine people, recommended by producers and appointed by the court; www.cbwm.org/
15—Cucamonga Basin	North central part of Upper Santa Ana Valley Basin; San Bernardino	8-2	1975	1978	Not yet appointed, operated as part of Chino Basin
16—San Bernardino Basin Area	Northeast part of Upper Santa Ana Basin; San Bernardino and Riverside	8-2	1963	1969	One representative each from Western Municipal Water District of Riverside County & San Bernardino Valley Municipal Water District
17—Six Basins	Six subbasins in northwest upper Santa Ana Valley; Upper & Lower Claremont Heights, Canyon, Pomona, Live Oak & Ganesha; Los Angeles. Small portions of Upper Claremont Heights and Canyon are in San Bernardino County	4-14, 8-2	1998	1998	Nine-member board representing all parties to the judgment
18—Santa Margarita River watershed	The Santa Margarita River watershed, including 3 groundwater basins: Santa Margarita Valley, Temecula Valley and Cahuilla Valley Basins; San Diego and Riverside.	9-4, 9-5, 9-6	1951	1966	U.S. District Court appointee
19—Goleta	Goleta Central Basin; judgment includes North Basin; Santa Barbara	3-16	1973	1989	No watermaster appointed; the court retains jurisdiction

How Successful Have Groundwater Management Efforts Been?

This chapter describes the opportunities for local agencies to manage their groundwater resources. Many have questioned whether these opportunities have led to an overall successful system of groundwater management throughout California. How successful groundwater management has been throughout the State is a difficult question and cannot be answered at present. While there are many examples of local agency successes (see Box F, “Managing through a Joint Powers Agreement,” Box G, “Managing a Basin through Integrated Water Management,” and Box H, “Managing Groundwater Using both Physical and Institutional Solutions”), there are neither mandates to prepare groundwater management plans nor reporting requirements when plans are implemented, so a comprehensive assessment of local planning efforts is not possible. Additionally, many plans have been adopted only recently, during a period of several consecutive wet years, so many of the plan components are either untested or not implemented.

At a minimum, successful groundwater management should be defined as maintaining and maximizing long-term reliability of the groundwater resource, focused on preventing significant depletion of groundwater in storage over the long term and preventing significant degradation of groundwater quality. A review of some of the groundwater management plans prepared under AB 3030 reveals that some plans are simply brief recitations about continuing the agency’s existing programs. Not all agencies that enacted groundwater management plans under AB 3030 are actively implementing the plan.

Despite this apparent lack of implementation of groundwater management plans prepared under AB 3030, the bill has certainly increased interest in more effective groundwater management. With more than 200 agencies participating in plans and more than 120 of those involved in coordinated plans with other agencies, AB 3030 has resulted in a heightened awareness of groundwater management. Additionally, annual reports published by a few water agencies indicate that they are indeed moving toward better coordination throughout the basin and more effective management of all water supplies. Given the history of groundwater management in California, these seemingly small steps toward better management may actually represent giant strides forward.

More recently, financial incentives have played a large role in driving groundwater management activities. For example, under grant and loan programs resulting from Proposition 13 of 2000 (see description in Chapter 4), local agencies submitted applications proposing a total increase in annual water yield of more than 300,000 acre-feet through groundwater storage projects. Additional projects and programs would be developed with sufficient funding for feasibility and pilot studies. Unfortunately, not enough funding exists for all of the proposed projects, and many other legal and institutional barriers remain (see Box I, “Impediments to Conjunctive Management Programs in California”). It is clear, however, that further incentives would help agencies move ahead more aggressively in their groundwater management planning efforts.

Additional progress in groundwater management is reflected by passage of amendments to the Water Code (§§ 10753.4 and 10795.4 as amended, §§ 10753.7, 10753.8, and 10753.9 as amended and renumbered, and §§ 10753.1 and 10753.7 as added) through SB 1938 of 2002. The amendments require that groundwater management plans include specific components for agencies to be eligible for some public funds for groundwater projects. The provisions of SB 1938 (2001) are fully described in Chapters 3 and 4.

This evaluation of groundwater management success has not really considered ordinances and adjudications. Adjudications have been successful at maintaining the groundwater basin conditions, often restricting pumping for all basin users. In some cases, adjudication provides the necessary framework for more proactive management as well. Ordinances have successfully restricted exports from basins, but have not

Box F Managing through a Joint Powers Agreement

In 1993, representatives from business, environmental, public, and water purveyor interests formed the Sacramento Area Water Forum to develop a plan to protect the region's water resources from the effects of prolonged drought as the demand for water continues to grow. The Water Forum was founded on two co-equal objectives: (1) to provide a reliable and safe water supply for the region's economic health and planned development to the year 2030 and (2) to preserve the fishery, wildlife, recreational and aesthetic values of the lower American River.

After a six-year consensus-based process of education, analysis and negotiation, the participants signed a Water Forum agreement to meet these objectives. The agreement provides a framework for avoiding future water shortages, environmental degradation, groundwater contamination, threats to groundwater reliability, and limits to economic prosperity.

The Sacramento Groundwater Authority (SGA) was formed to fulfill a key Water Forum goal of protecting and managing the north-area groundwater basin. The SGA is a joint powers authority formed for the purpose of collectively managing the region's groundwater resources. This authority permits SGA to make contractual arrangements required to implement a conjunctive use program, and also provides potential partners with the legal and political certainty for entering into long-term agreements.

SGA's regional banking and exchange program is designed to provide long-term supply benefits for local needs, but also will have the potential to provide broader statewide benefits consistent with American River environmental needs. Water stored in Folsom Lake would be conjunctively used with groundwater in order to reduce surface water diversions in dry years and to achieve in-lieu recharge of the basin in wet years. The conjunctive use program participants include 16 water providers in northern Sacramento and southern Placer counties that serve water to more than half a million people.

Two of three implementation phases of the program are complete. In the first phase, program participants identified long-term water supply needs and conducted an inventory of existing infrastructure that could be used to implement the program. In the second phase, SGA completed two pilot banking and exchange projects, demonstrating the technical, legal, and institutional viability of a regional conjunctive use program. In the first pilot study, water agencies worked with the U.S. Bureau of Reclamation and the Sacramento Area Flood Control Agency to bank 2,100 acre-feet of groundwater, providing additional flood storage capacity in Folsom Lake. In the second pilot study, Citrus Heights and Fair Oaks water districts and the city of Sacramento extracted and used 7,143 acre-feet of groundwater, forgoing a portion of their rights to surface water, making this water available to the Environmental Water Account. The third phase of the SGA program is to further solidify the institutional framework and construct facilities to implement a full-scale regional conjunctive use program. These facilities, that will result in an average annual yield of 21,400 acre-feet, are currently under construction, funded in part by a \$21.6 million grant under Proposition 13 of 2000.

Box G Managing a Basin through Integrated Water Management

Orange County Water District (OCWD) was established in 1933 by an uncodified Act (Water Code App. 40) to manage Orange County's groundwater basin and protect the Santa Ana River rights of water users of north-central Orange County. The district manages the groundwater basin, which provides as much as 75 percent of the water supply for its service area. The district strives for a groundwater-based water supply with enough reserves to provide a water supply through drought conditions. An integrated set of water management practices helps achieve this, including the use of recharge, alternative sources, and conservation.

Recharge

The Santa Ana River provides the main natural recharge source for the county's groundwater basin. Increased groundwater use and lower-than-average rainfall during the late 1980s and early 1990s forced the district to rely on an aggressive program to enhance recharge of the groundwater basin. Programs used today to optimize water use and availability include:

- Construction of levees in the river channel to increase infiltration.
- Construction of artificial recharge basins within the forebay.
- Development of an underwater basin cleaning vehicle that removes a clogging layer at the bottom of the recharge basin and extends the time between draining the basin for cleaning by a bulldozer.
- Use of storm water captured behind Prado Dam that would otherwise flow to the ocean.
- Use of imported water from the State Water Project and Colorado River.
- Injection of treated recycled water to form a seawater intrusion barrier.

Alternative Water Use and Conservation

OCWD has successfully used nontraditional sources of water to help satisfy the growing need for water in Orange County. Projects that have added to the effective supply of groundwater are:

- Use of treated recycled water for irrigation and industrial use.
- In-lieu use to reduce groundwater pumping.
- Change to low-flow toilets and showerheads.
- Participation of 70 percent of Orange County hotels and motels in water conservation programs.
- Change to more efficient computerized irrigation.

Since 1975, Water Factory 21 has provided recycled water that meets all primary and secondary drinking water standards set by the California Department of Health Services. OCWD has proposed a larger, more efficient membrane purification project called the Groundwater Replenishment System (GWRS), which is scheduled to begin operating at 70,000 acre-feet per year in 2007. By 2020 the system will annually supply 121,000 acre-feet of high quality water for recharge, for injection into the seawater intrusion barrier, and for direct industrial uses.

This facility will use a lower cost microfiltration and reverse osmosis treatment process that produces water of near distilled quality, which will help reverse the trend of rising total dissolved solids (TDS) in groundwater caused by the recharge of higher TDS-content Santa Ana River and Colorado River waters. The facility will use about half the energy required to import an equivalent amount of water to Orange County from Northern California. The GWRS will be funded, in part, by a \$30 million grant under Proposition 13 of 2000.

Source: Orange County Water District

Box H Managing Groundwater using both Physical and Institutional Solutions

Four agencies share responsibility for groundwater management in Ventura County. Coordination and cooperation between these agencies focus on regular meetings, attendance at each other's board meetings, joint projects, watershed committees, and ongoing personal contacts to discuss water-related issues. The agencies and their areas of responsibility are:

- United Water Conservation District – physical solutions, monitoring, modeling, reporting, administering management plans and adjudication;
- Fox Canyon Groundwater Management Agency – pumping allocations, credits and penalties, abandoned well destruction, data for irrigation efficiency;
- County of Ventura – well permits, well construction regulations, tracking abandoned wells; and
- Calleguas Municipal Water District – groundwater storage of imported water.

In Ventura County 75% to 80% of the extracted groundwater is for agriculture; the remainder is for municipal and industrial use. Seawater intrusion into the aquifers was recognized in the 1940s and was the driving force behind a number of groundwater management projects and policies in the county's groundwater basins. As groundwater issues became more complicated at the end of the 20th century, these groundwater management projects and policies were useful in solving a number of problems.

Physical Solutions

Physical solutions substitute supplemental surface water for groundwater pumping near coastal areas, increase basin recharge, and increase the reliability of imported water. Projects include:

- Winter flood-flow storage for dry season release
- Wells and pipelines to move pumping for drinking water away from the coast
- Diversion structures to supply surface water to spreading grounds and irrigation
- Pipelines to convey surface water to coastal areas
- Las Posas Basin Aquifer Storage and Recovery project

Institutional Solutions

Institutional solutions focus on developing and implementing effective groundwater management programs, reducing pumping demands, tracking groundwater levels and water quality, managing groundwater pumping patterns, and destroying abandoned wells to prevent cross-contamination of aquifers. Solutions include:

- Creation of Fox Canyon Groundwater Management Agency (GMA), which represents each major pumping constituency
- Use of irrigation efficiency (agriculture), water conservation, and alternative sources of water (urban) to reduce pumping by 25%
- Manage outside the GMA area through an AB 3030 plan and a court adjudication
- Limit new permits for wells in specific aquifers to avoid seawater intrusion
- Creation of a program to destroy abandoned wells
- Creation of a database of historical groundwater levels and quality information collected since the 1920s
- Development of a regional groundwater flow model and a regional master plan for groundwater projects
- Creation of an irrigation weather station to assist in irrigation efficiency

Implementation of these physical and institutional management tools has resulted in the reversal of seawater intrusion in key coastal monitoring wells. These same tools are being used to mitigate saline intrusion (not seawater) in two inland basins and to reduce seasonal nitrate problems in the recharge area. Work is being expanded to help reduce loading of agricultural pesticides and nutrients. Without close coordination and cooperation of the county's water-related agencies, municipalities, and landowners, it would have been very difficult to implement most of these solutions. Although such coordination takes time, the investment has paid off in solutions that help provide a sustainable water supply for all water users in Ventura County.

Source: United Water Conservation District

necessarily improved groundwater management. The primary intent of most ordinances is to ensure that proponents of projects are held accountable for potential impacts of the proposed export projects. As studies lead to a better understanding of local water resources, development of pilot export and transfer projects, with appropriate monitoring, may lead to greater certainty in managing groundwater resources. Areas managed under adjudications and ordinances will continue to develop more active management approaches. Population growth and its accompanying increased demand on the resources is a certainty. Most geographic areas in California are not immune to this growth, so strategies for more than just maintaining existing groundwater supply through extraction or export restrictions need to be implemented.

Box I Impediments to Conjunctive Management Programs in California

In 1998 the National Water Research Institute, in cooperation with the Association of Ground Water Agencies and the Metropolitan Water District of Southern California, conducted a workshop to determine the biggest impediments to implementing a cost-effective conjunctive water management program in California.

Since that time, some steps have been taken to overcome those impediments, but several important barriers remain. Workshop participants identified the 10 most significant obstacles:

- 1) Inability of local and regional water management governance entities to build trust, resolve differences (internally and externally), and share control.
- 2) Inability to match benefits and funding burdens in ways that are acceptable to all parties, including third parties.
- 3) Lack of sufficient federal, State, and regional financial incentives to encourage groundwater conjunctive use to meet statewide water needs.
- 4) Legal constraints that impede conjunctive use, regarding storage rights, basin judgments, area of origin, water rights, and indemnification.
- 5) Lack of statewide leadership in the planning and development of conjunctive use programs as part of comprehensive water resources plans, which recognize local, regional, and other stakeholders' interests.
- 6) Inability to address quality difference in "put" versus "take"; standards for injection, export, and reclaimed water; and unforeseeable future groundwater degradation.
- 7) Risk that water stored cannot be extracted when needed because of infrastructure, water quality or water level, politics, and institutional or contractual provisions.
- 8) Lack of assurances to prevent third-party impacts and assurances to increase willingness of local citizens to participate.
- 9) Lack of creativity in developing lasting "win-win" conjunctive use projects, agreements, and programs.
- 10) Supplemental suppliers and basin managers have different roles and expectations in relation to conjunctive use.

[Editor's note: The California Department of Water Resources' Conjunctive Water Management program has taken significant steps to overcome several of these impediments, using a combination of California Bay-Delta Authority, DWR, Proposition 13, and AB 303 funds to promote locally planned and controlled conjunctive use programs.]

Future Groundwater Management in California

Trying to predict what will happen with groundwater management in California is difficult given that actions by all of the involved groups—landowners, local governments, local, State, and federal agencies, and the courts—will continue to shape groundwater management in the future. However, the increasing population and its demands on California’s water supply will accelerate the rate at which groundwater management issues become critical and require resolution. Some general conclusions are:

- Groundwater management will continue to be a local responsibility with increasing emphasis on how actions in one part of a basin impact groundwater resources throughout the basin. Regional cooperation and coordination of groundwater management activities will increase.
- As the State’s population continues to grow, the increased reliance on groundwater will keep the topic of groundwater management at the forefront of legislative interest.
- Coordinated management of groundwater and surface water resources, through further development of conjunctive water management programs and projects, will become increasingly important.
- The increased reliance on groundwater in the future will necessitate a more direct link between land use planning, watershed management, floodplain management, and groundwater management plans.
- Current trends indicate that financial incentives in the form of loans and grants are increasing groundwater management planning and implementation at the local level. These successes will only continue at the current pace with increased funding to local agencies.
- Management of groundwater will increasingly include consideration of groundwater quality and groundwater quantity.
- Groundwater will be an important element in the trend toward an integrated water management approach that considers the full range of demand management and supply alternatives.
- Understanding of the relationship of groundwater and surface water and the role of groundwater in the environment will continue to grow.

Box J Managing Groundwater Quantity and Quality

When people hear the words “groundwater monitoring” they may think either of measuring groundwater levels or of analyzing for groundwater quality. In reality, monitoring and management of groundwater quantity and groundwater quality are inseparable components of a management plan.

Although the primary focus of the California Department of Water Resources (DWR) is on groundwater quantity and the measures taken by local agencies to manage supply, management must also consider groundwater quality. Natural or anthropogenic contamination and pumping patterns that are not managed to protect groundwater quality may limit the quantity of groundwater that is available for use in a basin.

Several State programs provide useful data as well as regulatory direction on groundwater quality that managers can use in managing their groundwater supply. One program is the Drinking Water Source Assessment and Protection Program prepared by the California Department of Health Services in response to 1996 amendments to the federal Safe Drinking Water Act. The DWSAP requires water purveyors to assess sources of drinking water, develop zones indicating time of travel of groundwater, and identify potentially contaminating activities around supply wells. The goal is to ensure that the quality of drinking water sources is maintained and protected. Other useful water quality data for groundwater managers is collected by the agencies within the California Environmental Protection Agency, including the State Water Resources Control Board, Department of Pesticide Regulation and the Department of Toxic Substances Control, which are discussed in more detail in Chapter 5. Each of these agencies has a specific statutory responsibility to collect groundwater quality information and protect water quality.

Protection of Recharge Areas

Groundwater recharge areas, and the human activities that can render them unusable, are an example of the need to coordinate land use activities to protect both groundwater quality and quantity. Protection of recharge areas, whether natural or man-made, is necessary if the quantity and quality of groundwater in the aquifer are to be maintained. Existing and potential recharge areas must be protected so that they remain functional, that is they continue to provide recharge to the aquifer and they are not contaminated with chemical or microbial constituents. Land-use practices should be implemented so that neither the quantity nor quality of groundwater is reduced. A lack of protection of recharge areas could decrease the availability of usable groundwater and require the substitution of a more expensive water supply.

Many potentially contaminating activities have routinely been practiced in recharge areas, leading to the presence of contaminants in groundwater. In many areas, groundwater obtained from aquifers now requires remediation. Recent studies in some areas show that recharge areas are contaminated, but down-gradient wells are not, indicating that it is only a matter of time before contaminants in wells reach concentrations that require treatment of the groundwater.

In addition to quality impacts, urban development, consisting of pavement and buildings on former agricultural land, lining of flood control channels, and other land use changes have reduced the capacity of recharge areas to replenish groundwater, effectively reducing the safe yield of some basins.

Box J Managing Groundwater Quantity and Quality (continued)

To ensure that recharge areas continue to replenish high quality groundwater, water managers and land use planners should work together to:

- Identify recharge areas so the public and local zoning agencies are aware of the areas that need protection from paving and from contamination;
- Include recharge areas in zoning categories that eliminate the possibility of contaminants entering the subsurface;
- Standardize guidelines for pre-treatment of the recharge water, including recycled water;
- Build monitoring wells to collect data on changes in groundwater quality that may be caused by recharge; and
- Consider the functions of recharge areas in land use and development decisions.

